SCIENCE:

A Weekly Record of Scientific Progress.

JOHN MICHELS, Editor.

TERMS:

Per Year,	Four Dollars
6 Months,	Two "
3 "	One "
Single Copies,	Ten Cents.

Published at

TRIBUNE BUILDING, NEW YORK.

P. O. Box 3838

London, England, - - - - 150 Leadenhall St.

SATURDAY, DECEMBER 24, 1881.

The glad tidings of the safety of a large proportion of the crew of the *Jeannette*, and the probability that the missing members of the company will probably be soon heard from, will be a relief to many aching hearts, and welcome to the general public who have taken a great interest in this expedition.

As the success of the expedition has not been referred to in the despatches, the probability is great, that the discovery of the North Pole is still a problem to be solved, but the experience of Captain De Long will doubtless prove very valuable in making future plans for Arctic explorations, and we trust that no time will be lost in obtaining authentic details of the expedition.

From what we know respecting the voyage of the *Jeannette*, and from other information to date, our opinion is that the route by Smith's Sound, is the most practicable for all who attempt to reach the North Pole, and we still maintain that the plans of Commander Cheyne present a higher prospect for success, than any other scheme which has been announced.

The first step which we advise, is to establish firmly a small colony at St. Patrick's Bay, where coal exists in abundance, and ample protection can be found for stores and shelter for men. This spot is less than 500 miles from the North Pole, and, with such a base of operations firmly established, the coveted prize can surely be won by continued and persistent efforts.

We approve of Commander Cheyne's proposal to utilize balloons, on the ground that no facilities which can be devised by practical scientific men should be neglected, and it is far from impossible that some means of aerial navigation may be invented, which may be at least sufficient for this purpose.

The establishment of the colony at St. Patrick's Bay, should be the immediate plan which should claim attention, without desiring by a rush to accomplish the remaining distance. Time should be given for traversing the 500 miles which intervene before reaching the Pole, and all the devices which science can suggest should in turn be put to the test.

We cannot conclude these remarks without giving a due acknowledgement to Mr. James Gordon Bennett for his liberal outlay in the cause of geographical exploration. Inspired by his generous hand, Stanley braved the horrors of tropical climates and penetrated to the unknown recesses of Africa, and by Mr. Bennett's aid De Long has added new laurels to the American flag, and increased our knowledge of the Arctic regions.

The presence of fossil organisms in meteorites alleged to have been discovered by Dr. Hahn, was fully explained in "Science" (No. 50, June 11, 1881) by Dr. Rachael. Since the appearance of this article I have discussed the subject with many specialists, with the result of finding a general distrust of Dr. Hahn's discovery.

I, therefore, endeavored to obtain a portion of the Knyahinya meteorite which fell in Hungary on the 9th of June, 1866, as many of the most convincing specimens were obtained by Dr. Hahn from it, and by the aid of Messrs Ward and Howell of the Natural History Museum, Rochester, N. Y., a small fragment of this meteorite recently reached my hands. From this specimen two sections were cut, and ground down to a condition of transparency by a gentleman skilled in such preparations, and are now mounted as microscopical objects.

An examination which I have since made confirms in every respect the correctness of Dr. Hahn's statement, as to what he saw, and it therefore remains only to decide whether the deductions he made were correct. The doubtful forms are very clearly defined and sufficiently large to be examined with precision by a 1-inch objective; one prominent object, which to the uninitiated might be taken for a diminutive clam shell, is found to measure 1-25 by 1-20 of an inch. I was disappointed to find that high powers failed to develop structure which indicated decisively the nature of these forms, and to show the difficulty of arriving at a correct solution, I may state that the two persons to whom I have so far shown the specimens, differed entirely as to their interpretation; the one pronounced them veritable fossils, and the second was equally sure that they were merely interesting forms of crystallization.

I reserve an opinion until the section has been studied with more attention, and comparison made with other specimens now being prepared; in the mean time I shall be pleased to show the section to any person who is interested in this subject, or able by previous study to throw any light on the subject.

John Michels.

XUM

THE AMERICAN CHEMICAL SOCIETY.

The annual meeting of the American Chemical Society was held on Friday evening, December 2nd, with Vice President Leeds in the chair.

After the reports from the various officers were read, the society proceeded to the election of officers to serve during the coming year.

The results were as follows:

President: J. W. Mallett.

Vice Presidents: A. R. Leeds, W. M. Habirshaw, E. Waller, L. A. Goessman, A. B. Prescott, N. P. Lupton.

Treasurer: T. O'C. Sloane.

The remainder of the ticket, as announced in the previous notice, were all elected with the single exception of the treasurer, whose name was substituted by that of Dr. Sloane, whose name on the nominating committee was replaced by that of Mr. A. P. Hallock.

The board of directors will be as follows:

P. Casamajor, Jas. H. Stebbins, Geo. A. Prochazka, H. Endeman, H. Morton, P. de P. Ricketts, T. O'C. Sloane, A. R. Leeds, W. M. Habirshaw, E. Waller, C. F. Chandler, J. B. F. Hernshoff, W. E. Geyer.

The reading of the papers announced for the evening was postponed until the conversazione, which will take place on the evening of the 16th inst.

"J. W. Mallett," says Prof. Silliman, "has for many years been an industrious worker, publishing original researches in chemical subjects, which form important contributions to our science."

Among the very first to work in the then newly isolated element, Tellurium, was Prof. Mallett. Under the direction of the celebrated Woehler these researches were made, and, in recognition of their merit, the university at Gottingen conferred the doctorate on the youthful scientist. Coming to this country, for Prof. Mallett is an Englishman by birth, he located himself at Philadelphia with Mr. J. C. Booth who, at that time, had among his students and assistants T. H. Garrett, the two Morfits, McCulloh and others whose names have since become distinguished.

Later on, in the records of American chemistry, the subject of our sketch was appointed Professor of Chemistry at the University of Alabama, and at present he fills the same position at the University of Virginia; he also lectures in applied chemistry before the students at the Johns Hopkins University. His printed papers are very numerous, most of the earlier ones may be found in *Silliman's Journal*, while those of a more recent date have been published in the *American Chemical Journal*. To this latter periodical he has been a faithful contributor since its commencement, and its columns have been enriched by his very interesting review "Of the Progress of Science Among the Industrial Arts During the Last Ten Years." Prof. Mallett served as one of the judges in Group III at the Centennial Exhibition, and furnished for the governmental reports a very satisfactory resumé of the sugar industry of the United States.

He is a member of the Royal Society of Great Britain, of the Chemical Societies of London, Berlin and Paris, as well as many other learned bodies both at home and abroad. The American Chemical Society have made a wise selection, and it is to be hoped that its new president will resume that desirable custom of presidential addresses, which unfortunately has been omitted during the past few years. M. B.

COMMANDER CHEYNE has started on his trip to Canada, and will return to New York about the 20th of January; in the interval Mr. Henry Walton Grinnell, who has consented to become Secretary of the committee to be formed to promote this expedition, will attend to matters requiring early attention.

THE NEW YORK ACADEMY OF SCIENCES.

Dec. 5. 1881.

REGULAR BUSINESS MEETING.

The President Dr. J. S. NEWBERRY, in the Chair.

Twenty six persons present.

Dr. NEWBERRY exhibited an ancient perforated stone axe from Europe, consisting of dioryte, and remarked that the aboriginal tribes of America never attained to the degree of skill required in the perforation of stone implements for the insertion of wooden handles.

The following paper was read by Dr. ALEXIS A. JULIEN.

THE VOLCANIC TUFFS OF CHALLIS, IDAHO, AND OTHER WESTERN LOCALITIES.

(Abstract).

In a paper recently read before the Academy it was shown that a certain compact white almost structureless rock, often porcellanous in texture, occuring abundantly in the Western Territories and variously styled "trachyte," "rhyolyte," "porphyry," etc., (*e. g.*, at Leadville, Colorado, in the Black Hills of Dakota, etc.), is a sedimentary form of a highly silicious volcanic tuff, probably derived from the finest detritus of trachytes, rhyolytes, and quartz-porphyries. A series of specimens collected by Prof. NEWBERRY, during the last and previous summers, and kindly put in the author's hands for lithological examination, has furnished the material for the following additional notes on this interesting but neglected group of widespread American rocks.

1. *Coarse pumice-tuff of Challis, Idaho.*

The rock is quite compact, chistose, of a gray color with dull white spots. The latter consists of pumice in finely fibrous grains, from 1 to 5 mm. in length. Quartz and feldspar are seen in small angular flakes, sometimes reaching 0.5 mm. in length: hornblende commonly in fibrous black fragments, about 1 mm. in diameter: and much biotite, brownish-green, sometimes brownish-black, with greasy lustre, in hexagonal scales, often up to 2 to 3 mm. in size.

The thin sections present under the microscope numerous grains, generally angular, of several minerals, varying in size up to 3 or 4 mm.: pumice in rounded to sub-angular fawn-colored fragments lying at all angles, commonly made up of straight or curved fibres, and often including glass lenses filled with crystallites: a trichinic feldspar, in clear grains, sometimes including minute globules of glass, and possessing fine lamellation, beautifully striated in polarized light, the remaining traces of crystalline outlines indicating that these grains are all of fragmentary, never of indigenous formation: quartz, in water-clear angular grains, 0.2 to 1.6mm. long, retaining more frequent and perfect traces of their crystalline forms, their sides being often very ragged, curiously and deeply eroded into rounded indentations, while within occur numerous inclusions of the ground mass and of scales of biotite, long greenish needles of hornblende, and sub-angular drops of a brownish-violet glass with one or several fixed bubbles of gas: biotite in abundant irregular scales, 0.2 to 1.3 mm. long, brown inclining to maroon or brownish-yellow, cloudy to opaque, with some dichroism remaining in the striated sections; hornblende in brownish-green, strongly dichroic, fibrous crystalline flakes: opacite, probably magnetite, and ferrite or iron-oxide, in dusty particles or groups in the biotite scales and among the pumice fibres. The fine groundmass is mainly composed of minute fragments, fibres, scales, etc., of all these minerals: also in large part of solid globules of fawn-colored glass, or of thin and apparently hollow shells, or of fragments of quartz or feldspar coated with a glass crust. Many of

these forms are found adhering in curious aggregations or with their sides crushed in.

The general constitution of this rock is similar to that of the volcanic tuff of the El Dorado Cañon, Cal.

2. *Fine green volcanic tuff, of Challis, Idaho.*

A very fine compact rock, with almost the texture of stoneware, with a pale, greenish-gray color, and a very thin parallel lamination. A few minute scales of biotite can be distinguished by the loup. The surfaces of fissures are mottled and spotted with bluish-green and ochreous, brownish-gray films.

The thin sections present the same constitution as that of the coarse variety of the rock, without the presence of pumice, the particles of quartz and feldspar varying in size from 0.06 to 0.25 mm. Biotite is abundant in scales 0.1 to 0.2 mm. in diameter, often of ochreous shades of brownish-yellow and maroon, through partial decomposition, and with curved fibres or wrinkles as if crushed in by pressure. To its abundance are due the fine lamination of the rock and, in part, its greenish color. The ground mass largely consists of globules of colorless glass, but in less degree than in the preceding variety, their size varying from 0.006 to 0.01 mm.

3. *Fine white pumice-tuff, of Challis, Idaho.*

A very fine compact rock, grayish, with a bronze shade, with a lamination so decided that it inclines to slaty. Under the loup the same constituents are visible as in No. 1.

The thin sections show a close relationship to those of No. 2. A little hornblende is present. Biotite occurs in distinct scales, sometimes hexagonal, not so minutely dispersed as in No. 2, generally 0.01 to 0.1 mm. in diameter. The fragments of quartz and feldspar, as a rule, present their longer axes in the schist plane, varying from 0.03 to 0.22 mm. in length. The glass inclusions in the quartz, ranging from 0.002 to 0.037 mm. The ground mass appears to be mainly composed of pumice, more or less altered, in very minute fibres and particles.

This rock strongly resembles the tufa of the lignite beds near Osarisawa, Akita, Japan.

4. *Pumice-tuff, Moore Station, Pancake Range, Moray, Nevada.*

This rock is decidedly ochistose, cream colored, nearly white, of a fine grain, intermediate between Nos. 1 and 2, most of the constituents being the same as in No. 1 and less than 0.5 mm. in diameter, though occasional grains of pumice, gray and red obsidian, and perfect crystals of quartz may reach from 2 to 8 mm. in length.

In the thin section the constituents are found disposed with great regularity: pumice, with its fibres often curved, as if crushed while still soft and plastic: quartz: trichinic feldspar: possibly sanidine: magnetite: ferrite: biotite, salmon colored, sometimes very cloudy: and volcanic glass in cellular network, often full of gas bubbles, elongated and distorted. In the ground mass, globules of glass and fibres and threads of pumice largely predominate.

The pumice in all these tuffs is not perfectly isotrope between the crossed nicols, but presents innumerable, though exceedingly minute glittering points, apparently crystallites formed by incipient devitrification. A few minute spherœlites were also detected.

5. *Stratified Rhyolye-tuff, Tempiute, Nevada.*

A snow-white Kaolinic variety, related to the preceding, which appears to consist principally of pumice. A few grains of black obsidian and red quartzite occur, the latter also as a somewhat rounded pebble, 34 mm. in length.

The thin section, transverse to the schist-plane, presents an interesting structure, made up of granular layers alternating with others possessing strong fibration.

The material of the former is mostly like that of No. 4: feldspar is sparsely scattered: quartz fragments abound, with the usual glass inclusions, and with sides deeply eroded and indented: also magnetite, ferrite, and minute colorless particles of a polarising mineral, perhaps Augite, in a predominant groundmass of particles and fibres of pumice and glass, rich in dark gas-bubbles.

The alternating fibrous laminæ consist of a true rhyolyte material, salmon-brown, with a marked fluidal structure around the few quartz-grains, and displaying in spots, and especially next the junction, with granular material, the constituent pumice-fibres whose partial interfusion or cohesion seems ordinarily to have produced the solid laminæ.

The arrangement of the glass fibres in parallel planes may have been produced by sorting in the air during their fall, by later superincumbent pressure while still hot and plastic, or it may be in some instances by the influence of overflowing lava-sheets. The cohesion produced by such downward pressure and interfusion has produced a structure which can hardly be distinguished from that of many obsidians and rhyolytes.

6. *Fine white pumice-tuff, from mouth of Bill Williams fork of Colorado River, Arizona.*

A compact white schist, with almost the fine texture of No. 3, traversed in places by brown curved impressions, apparently produced by rootlets.

The thin section mainly exhibits a very finely felted mass of short, straight fibres of pale brownish pumice. Besides these only a very few black particles of magnetite, feldspar, etc., were distinguished.

7. *Fine brownish pumice-tuff, from last locality.*

A brownish variety of the preceding, with abundant minute black particles. The slaty lamination is decidedly marked, with slight adherence over many planes at which the rock breaks easily, presenting remarkably flat surfaces.

The constitution displayed in the thin section is similar to that of the preceding specimen. Minute glass globules are abundant, and also more numerous angular particles of other minerals: colorless feldspar (sanidine?) showing cleavage: brownish and greenish augite: brownish and dichroic fibres of hornblende, and black particles of magnetite.

8. *Stratified pumice-tuff, from Black Mountains, Colorado river, Arizona.*

A coarser stratified tuff with brown and white layers, in which grains of pumice, obsidian, glassy feldspar, and quartz reach a diameter of 1 to 5 mm.

The thin section is rich in pumice in all its fibrous, curving, and reticulated forms, and in minute globules, threads, and shreds of volcanic glass: angular grains of finely lamellated plagioclase, water-clear quartz, and sanidine with well marked cleavage and often zonal stricture: particles of biotite, hornblende, magnetite and ferrite: abundant grains of augite, angular to rounded, sometimes retaining its optical characteristics in spots, but mostly decomposed and isotrope, colorless, brownish-yellow, light to deep maroon, etc., finely granular, thready, or fibrous, and more or less darkened by opacite even to complete opacity.

9. *Basalt-tuff, or peperino, Chenniti Mts., Texas.*

A fine-grained olive-green rock, with white streak, friable to arenaceous, with barely perceptible schist structure in the specimen. Under the loup, minute granules of feldspar, quartz, etc., are distinguishable, rarely 1 mm. in diameter, embedded in a grayish-green cement.

In the thin section the constituents are very much the same as in No. 8, with the exception of hornblende, and all the grains are in large part rounded. A few elongated rounded grains of a basaltic lava are also included, highly micro-crystalline with minute ledge of plagioclase scattered through a reddish-brown opaque base.

This specimen, and perhaps the preceding, represent the basic division of the tuffs, being ejections from an eruption of basaltic lava, though naturally composed of its more fluid, glassy, and acid scoria.

From these facts it may be concluded that enormous

XUM

masses of volcanic tuffs of widely varying character are dispersed throughout these regions in the West to an extent which could hardly be appreciated from the meagre references in our present petrographical literature.

In his discussion of the rhyolytes of the fortieth parallel, Zirkel remarks :*

"The foregoing descriptions show in what abundance those fibrous bodies in which the fibres are not grouped radially around a centre, as in sphœrolites, but arranged axially along a longitudinal line, are disseminated through these rhyolites.... These axiolites usually consist of distinct, uniformly thin fibres, or of wedge-like particles.... We see in the arrangement of the fibres in these rhyolites four different types: *a*, centrally radial: *b*, longitudinally axial: *c*, parallel: *d*, confused and orderless. The development of fibres is, indeed, a phenomenon very characteristic of rhyolites, etc., etc.'

A comparison of these facts with those presented in my examination of these tuffs appear to me significant, not of the development of fibration, etc., in a fused mass, but of the fragmental origin of at least many rhyolytes, obsidians, etc., as suggested in the study of No. 5. The evidences of the hot and plastic condition of the fibres and drops of volcanic glass, with the occasional exception of a cooled outer shell, for a long time after their fall, and of a tendency to the growth of microliths, sphœrolites, etc., within them, may offer another mode of origin for the formation of axiolites and sphœrolites. The anomalous presence of augite in a quartzose rock like rhyolyte, to which Zirkel calls attention in the same passage, may also find explanation in the varied intermixture of minerals which prevails in many tufts, rather than to indigenous development within an acid lava.

Dr. NEWBERRY said that he had no doubt that Mr. Julien was quite correct in regard to the genesis of the peculiar rocks which he had described. He had collected the specimens and was able to supply some facts in regard to their mode of occurrence. They belong to a series of rocks, plainly volcanic, but of which the history has not been given by those who have studied the volcanic rocks of the West. The circumstances of their occurrence are briefly these: over a great belt not less than one thousand miles wide in some places, viz., from the crest of the Sierra Nevada to the eastern foothills of the Rocky Mts., and with a north and south extension of thousands of miles in British Columbia, the United States and Mexico, we have an extraordinary display of the products of volcanic action. This is the great silver belt of the world, and is also rich in mines of gold, copper, lead, etc. Throughout all the Paleozoic and Mesozoic ages this country was an unbroken though not entirely unwarped sub-marine or sub-aerial plateau, where the most continuous and extensive series of sedimentary rocks was deposited of which we have any knowledge. At the close of the Jurassic age the western portion of this region was folded up, to form the great chain of the Sierra Nevada and Cascade Mts., and along this line of fracture numerous volcanic vents were established, Lassen's Butte, Mt. Shasta, Mt. Hood, Mt. Baker, etc., which have continued in intermittent activity to the present day. In Tertiary times the plateau east of the Sierra Nevada was broken up by a series of north and south fractures resulting in the formation of the remarkable system of meridional mountain ranges which constitute the chief topographical features of the district. These mountain ranges are composed of blocks of Paleozoic limestones and sandstones --now converted into marbles and quartzites—set up on edge or at a high angle, or of volcanic materials which have welled up through some of the fissures. Along the lines of fractures are great numbers of hot springs, the representatives of thousands more which existed in former days, and to which we owe the great system of fissure veins of this country :—hot water charged with mineral matter gradually depositing this and filling the channels through which it flowed.

The volcanic rocks which have been poured out in so many places exhibit a great variety of physical and chemical characters, but have been grouped by RICHTHOFEN and ZIRKEL into five species—propylite, rhyolite, trachyte, andesite and basalt. Capt. DUTTON who has given great attention to the volcanic rocks of the West, has distinguished a larger number of kinds and has adopted a different classification. Aside from these massive rocks there is another group which constitutes a marked feature both in the topography and geology, and these are those which have been made the subject of Mr. JULIEN'S paper. They are generally soft in composition, often highly colored,—white, red, blue, green, gray or yellow—more commonly white, red or gray. They are often quite local and usually occupy the lowlands, frequently underlying much of the level surface between the mountain ranges; and their best exposures are seen in the banks of streams which have cut these lowlands. There they are shown to be often horizontally bedded and sometimes interstratified with lacustrine sediments and sheets of basalt. Typical exposures of these rocks may be seen at Eureka, Nevada, where houses and cellars are excavated in the soft material which forms the sides of the valley; at Challis, in the banks of Salmon River and Garden Creek, whence the specimens described by Mr. JULIEN came, and in the cañons of the Des Chutes and its tributaries in Oregon.

Economically these rocks have considerable importance as they are extensively used in place of fire brick for lining lead smelting furnaces, being very refractory, and easily dressed into shape with an old axe.

The above section represents the filling of some of the fresh water lakes which formerly existed in Oregon just east of the great volcanic cones of the Cascade Mountains. Numbers 1 and 11 represent sheets of basalt, the even number softer tuffs and bed of diatomaceous earth, the odd numbers consolidated conglomerates of volcanic materials called "concrete" in my notes.

The study of a large number of outcrops of this series of rocks from Southern Arizona to the Columbia River has convinced me that they are generally volcanic ashes which have been washed down and more or less perfectly stratified in bodies of water which formerly occupied the intervals between the mountain ranges of the great basin. On the Des Chutes a section of more than 1000 feet shows 25 alternations of strata, many of which are examples of the rocks in question. Here they are interstratified with beds of tripoli, composed of fresh water diatoms, and layers of basalt. Some of the ash beds are almost entirely composed of lapillae of soft cottony pumice, others are finer, grey, red, white, etc., and contain the trunks of coniferous trees, and in some instances

* U. S. Geol. Expl. 40th Par., VI, Microsc. Petrog., pp. 201-205.

are pierced with holes which represent the stems of upright plants, thickets of which were buried by the descending showers or rapidly accumulating sediment of volcanic ash. Here the source of the materials is to be sought in the line of great volcanic vents which crown the summit of the Cascade Mountains, and from which, at intervals, were emitted either floods of lava, poured down on to the plain along the eastern border of the range, or showers of ashes which, borne inland by the prevailing westerly winds, fell on forest, savannah and lake, temporarily destroying animal and vegetable life and forming, when falling or washed into water basins, strata which alternate with fossil beds, the accumulations of quieter times. In other places these tufaceous deposits were washed from all the highlands into the valleys, forming local masses of considerable thickness without the intercalated beds mentioned above.

The accompanying section, copied from my report on the Geology of Northern California and Oregon (Pacific R. R. Report, Vol VI, Geology, p. 47), will illustrate the deposition of these tufaceous rocks in the lake basins where they are interstratified with the fossiliferous beds.

THE SCIENTIFIC SOCIETIES OF WASHINGTON, D. C.

THE PHILOSOPHICAL SOCIETY.—During the month of November three very important papers were read: on the Anomalies of Sound Signals, by President James C. Welling; on the Storage of Electric Energy, by Mr. J. C. Koyl; and on Barometric Hypsometry, by Mr. G. K. Gilbert.

The first named paper was a comprehensive review of the vexed discussion concerning the anomalies observed in the transmission of sound, and the summation of the result in a series of twelve aphorisms. The second paper was by a fellow of Johns Hopkins College, with reference to a series of experiments lately made by him in company with some Washington gentlemen upon an invention for the storage of electricity. Mr. Gilbert's communication had reference to a scheme of measuring altitudes by means of two barometric stations in the same vicinity, the one quite elevated, the other as low as convenient. By this means the influence of the thousand and one local causes affecting the barometer would be more thoroughly brought under the knowledge of the observer.

THE BIOLOGICAL SOCIETY.—The following communications have been made during the past month: on the Philosophy of the Retardation of Development Among the Lower Animals, by Prof. C. V. Riley; Antiquity of Certain Types of North American Non-Marine Mollusca, and the Extinction of Others, by Dr. C. A. White; Recent Explorations of the U. S. Fish Commission, by Mr. Richard Rathbun.

Professor Riley drew the attention of the society to a number of instances where the development of insects had been retarded in the embryo stage for a very long time. This did not refer to the well known retardations of whole broods, but to wholly exceptional cases. The speaker attributed the phenomena to evolutionary causes, and showed how a species might be saved from the wholesale destruction of a very severe winter or other disaster by this means.

Professor White's paper had reference to the survival from very high antiquity of many of the fresh water and brackish water forms, and to the total disappearance of others, for which events no adequate causes can be assigned.

Mr. Rathbun's communication was a review of the work of the Fish Commission from its foundation, illustrated by a map locating every dredging station; by a papier maché model of the Atlantic bottom as far out as the deep soundings, from the mouth of the St. Lawrence southward, and by specimens of the apparatus employed as well as the fauna discovered. The address was necessarily very comprehensive, but exceedingly interesting. At the same time the attention of the society was called to a pamphlet by Prof. G. Brown Goode, entitled "The First Decade of the United States Fish Commission, its Plan of Work and Accomplished Results, Scientific and Economical, Salem, Mass.: Salem Press, 1881."

THE ANTHROPOLOGICAL SOCIETY.—Three papers were also read before this society in November, to wit: How Shall the Deaf be Educated? by President E. M. Gallaudet; a Navajo Myth, by Mr. R. L. Packard; the Regulative System of the Zunis, by Prof. J. Howard Gore. The education of the deaf must be preceded by a proper classification of the heterogeneous group commonly called deaf mutes. The question of the relative superiority of the sign language and of visible speech was discussed with great minuteness. The author also treated the problem of heredity, of relative intelligence, and of the power of abstraction, with great ability.

Mr. Packard's myth was one taken by him last summer from one of the Navajo tribe and related to the origin of the Navajos.

Mr. Gore has spent some years upon the evolution of deliberative assemblies and the conduct of such bodies. Last summer, being in charge of a surveying party in New Mexico for the government, he availed himself of his opportunities to become familiar with the customs of the Pueblo Indians in such matters. These papers will be published in the proceedings of the Society.

DIAGRAMMATIC REPRESENTATION OF STEREOSCOPIC PHENOMENA.

(Continued from p. 548, Nov. 19th, 1881, in Transactions of N. Y. Academy of Sciences).

In a previous article (8) it has been shown that no reliance can be placed upon the theory of apparent distance in the stereoscope, elaborated by Wheatstone and Brewster, and applied in the diagrammatic explanation of stereoscopic phenomena in all our text books on Physics. We may well ask, therefore, to what extent it is possible, by any diagram, to represent the position of objects as they should appear in the stereoscopic field of view. So far as this is determined by the relation between the visual lines we may secure an approximation only by the following method, in which it must be assumed that we know also the relation between the camera axes at the time the photograph was taken. Since the visual lines may be practically regarded as special secondary axes to the crystalline lenses, it will be found convenient to call them visual axes, and their possible relations, axial convergence, parallelism, and divergence. It may be well also to restate two principles that have been sufficiently demonstrated elsewhere.

I. A point farther or nearer than the point of sight is necessarily seen double (9) and with imperfect focalization. If farther, the internal rectus muscles of the eyeballs must be slightly relaxed to make it the point of sight; if nearer, they must be contracted. Such relaxation is habitually associated with remoteness, such contraction with nearness, of the point fixed.

II. If an external point is imaged upon corresponding retinal points, the subjective effect is that of union of the two eyes into a central binocular eye, the nodal point of which is the point of origin in all estimates of direction and distance.(10)

A brief preliminary proof of a geometrical principle to be applied is also necessary. Let C and C', fig. 1, be two fixed points, and E midpoint between them on a horizontal plane. Let this plane be cut by four vertical planes, parallel to each other, their traces being marked I, II, III, and IV. Let B and Q be any points of plane I, from which straight lines are drawn to E, piercing plane II at A and P respectively. Through C and C' let pro-

jecting lines be drawn from A, B, P and Q to plane IV. It is required to find what relation exists between the horizontal displacements of the projections, a from b, p from q, a′ from b′, p′ from q′.

Since CC′ is horizontal, the projected horizontal displacements will be the same for all elevations of B and Q; these may hence be taken as points on the horizontal trace of plane I.

Since EC=EC′, we have

$Pq_2=Pq'_2=Ab_2=Ab'_2$

$\therefore$ pq=p′q′=ab=a′b′.

This equality will not exist if E be not midpoint between C and C′. It is true for all points in planes I and II respectively, through which straight lines can be drawn to E.

Let now C C′, fig. 2, be the distance between two camera lenses, for example 15^{cm}; A and B, objects in the foreground and background of a landscape, on the median line from E; Aa, Aa′, Bb, Bb′ secondary axes extending to the sensitized plate. The stereoscopic displacements on the photographic negative, a b and a′ b′, are equal to each other and to those of any other points, P and Q, related to the midpoint E, as they are in Fig. 1.

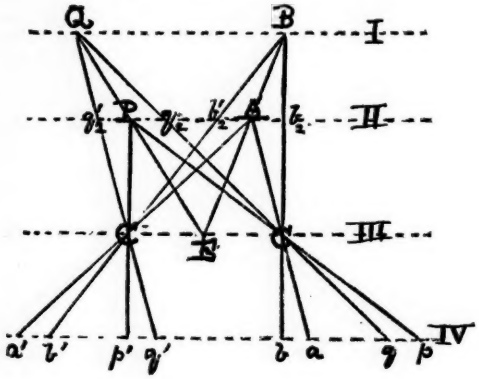


Fig 1.

The camera axes to A make a known angle, θ, with each other. Let E be midpoint also between a pair of eyes, R and L. If proofs from the negative be inverted and placed in front of R and L in such manner that the visual axes through a_1 and a'_1 shall form with each other an angle, α, equal to θ, then A_1 and B_1 are, as nearly as possible, the apparent positions of foreground and background respectively. If α exceed θ, A_1 will be nearer, if α be less than θ, A_1 will be farther; and this will be true if $\alpha = 0$, or $\alpha < 0$. Either of these last conditions is attained by simply increasing the distance $a_1a'_1$. Whether the visual axes are convergent, parallel, or divergent, the *subjective* effect is that of the union of R and L into a binocular eye which, for the geometrical reasons just given, can be nowhere else than at the midpoint, E. In this the dissimilar retinal images are superposed. If those of the points a_1 and a'_1 coincide, b_1 appears to the right eye projected outward on the right, to the left eye an equal distance outward on the left; to the combined eye it is a homonymous double image. Let A_2 be the external projection of the combined images of a_1 and a'_1, as seen by the binocular eye at E_2; if $\alpha = \theta$, the distance E_2A_2 is equal to RA_1 or LA_1, which differs but little from EA_1 unless α be large; it has been drawn equal to EA_1. Then B_2 and B'_2 will be the external projections of the uncombined images of b_2 and b'_2. If the attention be transferred to the background, the angle between the visual axes must be diminished by relaxing the internal rectus muscles, and this instantly suggests greater remoteness of the point of sight. The retinal images of b_2 and b'_2 coalesce and are projected to the more distant external point between B_2 and B'_2, while those of a_2 and a'_2 cross slightly to opposite sides and are projected as a heteronymous double image at its proper distance. The ratio of E_2A_2 to EA_1 must depend upon the variation in muscular tension due to the difference between the angles θ and α. The duplication of the images of the background points when the foreground is regarded, and *vice versa*, is easily perceived if a properly constructed diagram is viewed in the stereoscope, provided the observer be attentive to his own sensations, examining each point of the combined picture separately instead of regarding

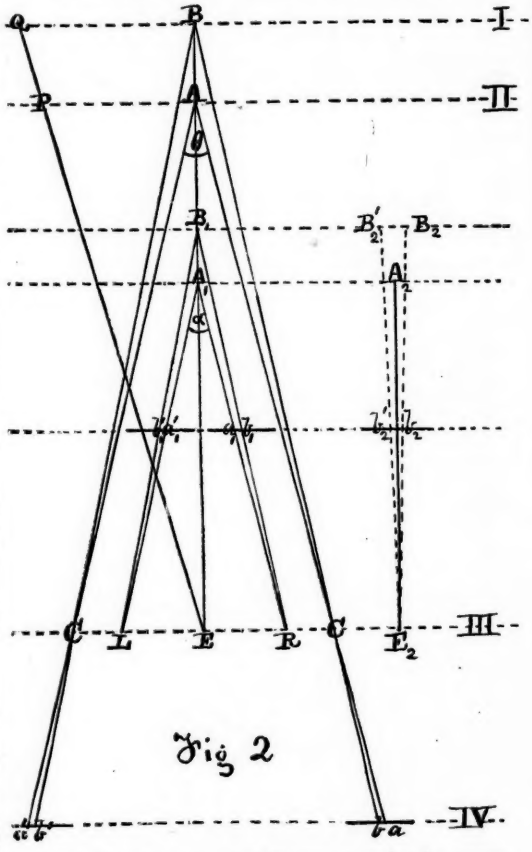


Fig 2

the total effect at once. Let Figures 3 and 4 be examined in the stereoscope, by resting the edge of the page on the cross-bar of the instrument at the proper distance in front of the semi-lenses. In each case, when the foreground circle is seen single, the background dot is seen double, and *vice versa*. When the background circles of one figure are combined binocularly, those of the other are seen separately by monocular vision. Axial convergence is necessary to combine the circles of Fig. 4. The combined image appears nearer, smaller, and less tall in proportion to its base than the combined image of Fig. 3, which requires axial divergence. The stereoscopic displacement is the same in both figures, and is measured by the distance between the centre of the large circle and that of the small one within it. The stereographic interval for the background is 90 mm. in

Fig. 3, and 50 mm. in Fig. 4. An average lenticular stereoscope will fail to produce axial convergence when Fig. 3 is viewed by a pair of eyes whose centres are 64 mm. apart. These variations in visual effect can be rendered still more striking by using the reflecting stereoscope, after cutting apart the right and left halves of the stereograph.

It must be remarked that although the perception of binocular relief is intensified by alternate examination of foreground, and background it is quite possible to attain it by momentary illumination with the electric spark, at least with convergence of visual axes, as has been done by Dove ([11]) and others. During such brief illumination, no variation of convergence is possible, and, if the foreground be distinctly focalized, the background must be slightly doubled homonymously. The position of the point of sight is found thus to be almost as nearly determinate as when the illumination is prolonged. Whether binocular relief, and the position of the binocular image, be perceptible with equal distinctness when the visual lines diverge, has not thus far been ascertained by experiment, so far as I am aware. I hope to test this, and to study certain other points of interest connected with it, at some future time.

Since the apparent distance of the point of sight continues to increase in a positive direction after axial parallelism passes into divergence, it becomes necessary to investigate the physiological conditions that interfere with the results of the mathematical theory hitherto generally applied.

In looking at any picture constructed in accordance with the rules of perspective applied by all artists, the illusion of distance is quickly attained by forming a conception of the reality in space to which the different parts of the picture are supposed to correspond, or of the object as the observer has been accustomed to view things of its kind. With the same degree of axial convergence a mountain and a piece of statuary will never be judged equally distant. It is unnecessary here to enumerate the elements that combine to produce the illusion. If these be excluded to the utmost, as in mere skeleton diagrams, there will still be left three to consider in judging the distance, size, and form of what is represented. These are—

I. The optic angle between the observer's visual axes.
II. The focal adjustment of the crystalline lens.
III. The visual angle subtended by the picture.

Of these the first is the only one usually considered as *distinctive* of binocular vision. It can never be dissociated entirely from the others, and its effect may be so overpowered by them, when distance is to be estimated, that calculations based upon its value, like those of Brewster, lose all claim even as approximations to the truth. Its true importance is dependent upon the extent to which the individual, in natural binocular vision, has been accustomed to associate the sensation of muscular contraction in the rectus muscles of the eyeballs with the true distance of objects as learned by other means. Doubtless this varies with different individuals. For distances of more than 240 m. the optic angle becomes inappreciable, and hence theoretically valueless; its importance is greatest near the lower limit of distinct vision. In every case its effect is appreciated mainly through the muscular sense and through the retinal perception of double images from objects farther or nearer than the point upon which attention is fixed. We are safe in disregarding the mere fact that a pair of imaginary lines *would* make a measurable angle with each other *if constructed*, though the use of this angle may be convenient in analyzing the phenomena of vision. It is well to remember, however, that its variations imply simply changes of muscular tension, and these constitute the most appreciable effects that influence the estimate of limited distance.

The judgment due to focal adjustment is also an interpretation, based upon personal experience, and suggested by the sense of contraction in the ciliary muscle, while adapting the crystalline lens to produce a distinct image. Variations in this are hence inappreciable for distances of more than 6 m., and are most noticeable near the lower limit of distinct vision. It is near this limit that the stereograph is held in most cases when regarded.

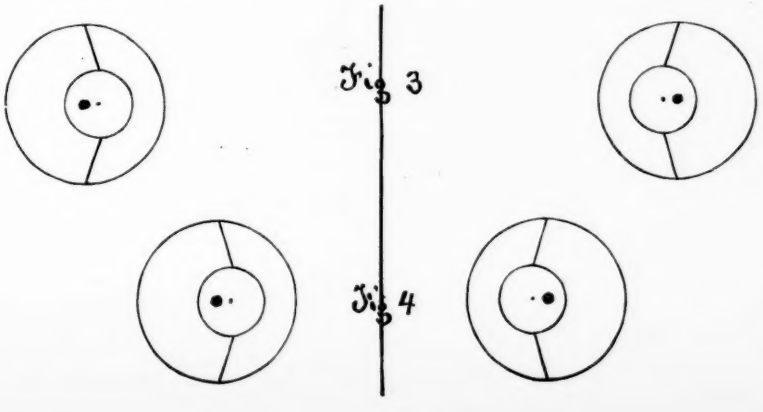
The visual angle is important as chiefly determining the size of the binocular retinal image. Since two eyes receive more of the light reflected from a given surface than either eye alone, the binocular image appears brighter than one that is monocular; and this is apt to produce the illusion of slight decrease of distance, if the focalization is perfect. But variation due to this cause is not important in comparison with that due to change in the visual angle.

The relative importance attached to the separate elements enumerated depends most frequently upon the unconscious experience of the individual. The results which they combine to produce cannot be referred to any one mathematical formula until the physiology of sensation is completely brought within the domain of mathematical law.

In testing the effects of these elements it will be best to apply a formula for the distance of the optic vertex from each eye, in terms of the interocular distance, i, and optic angle, α. Assuming the optic triangle to be isosceles, and calling D the required distance, we have, as the formula to be tested by experiment,

$$D = \tfrac{1}{2}\, i \operatorname{cosec} \tfrac{1}{2}\, \alpha.$$

Considering angles of convergence positive, the possible values of α, between which I find myself limited, are + 80°



and $-7\frac{1}{2}°$, my eyes being perfectly healthy. If a curve be constructed from the formula, the values of a being taken as abscissas and those of D as ordinates, for parallelism of visual lines we have $a = 0$, $D = \infty$, and the axis of ordinates is hence an asymptote. A vanishing point should therefore be reached by the external binocular image. Its apparent distance, however, is still finite, and vision very easy. In passing to negative values of a by increasing the stereographic interval, the distance estimated continues to grow in a positive direction. This is undoubtedly due to the sense of increasing relaxation of the internal rectus muscles and contraction of the external rectus; but the rate of growth bears no recognizable relation to any succession of values given by the formula.

The explanation just given is based upon experiments, the description and discussion of which must be withheld for the present. It may be simply stated that with binocular fusion of images from the same pair of conjugate pictures, I have tested the visual effect of varying the optic angle from $-5°$ to $+45°$, vision becoming indistinct after the last named limit is passed. The value of the optic angle has been found to be largely, but by no means exclusively, effective in determining apparent distance in the stereoscope, especially for convergence of visual axes. Its effect is antagonized by the difficulty of focal adjustment and by the constancy of the visual angle, the latter element being particularly important when the axes diverge.

The variation in apparent magnitude of the combined image, dependent upon the value of the optic angle, has been noticed by Wheatstone ([12]), Helmholtz ([13]), and Meyer ([14]). Helmholtz constructed his telestereoscope ([15]) for producing exaggeration of perspective when distant objects are viewed, but no reference is made, in this connection, to divergence of visual lines. The possibility of fusion by optic divergence seems to have been first noticed about 1860, by Burckhardt ([16]); and Helmholtz notices the exaggeration of apparent distance thus produced, but explains it by saying ([13]), "Infinity does not, in our visual conceptions, present an impassable limit. When our eyes occupy a position which is never presented in the normal observation of real objects, all that we can do, conforming ourselves to the rule which we ordinarily follow for the interpretation of abnormal sensations, is to compare the sensation produced with that which resembles it most, and which is distinguished from it only by more feeble convergence, that is, with what is given us by real objects very remote." Vision in the stereoscope is always to some extent abnormal. The error into which Brewster fell, and in which he has been generally followed, was in supposing that under such conditions no modifications would be imposed upon the mathematical law found applicable to normal vision, in which there is perfect coincidence between the impressions traceable to the optic angle, focal adjustment, and visual angle respectively.

W. LE CONTE STEVENS.

THE German government is considering the participation of German men of science in the plan of International Polar Research. The Reichstag has been asked to grant the necessary funds $75,000.

REFERENCES.

([8]). "Science," Nov. 19th, 1881, and American Journal of Science for Nov., 1881.
([9]). Helmholtz, Opt. Phys., p. 878, *et passim*: or, Le Conte, Sight, pp. 90–144. Appleton, 1881.
([10]). Hering, Beiträge zur Physiologie, pp. 35–64, 1861; or, Le Conte, Sight, pp. 213–261, 1881.
([11]). Helmholtz, Opt. Phys., pp. 935–937, 873–877, 961–964.
([12]). Phil. Mag., 1852, p. 507.
([13]). Opt. Phys., pp. 823–828.
([14]). Pogg. Ann., lxxxv., p. 198.
([15]). Opt. Phys., p. 821.
([16]). Verhandl. d. Naturforsch. Gies. zu Basel. I, 145; or, Opt. Phys., p. 827.

FOREIGN NOTES ON THE SOURCE OF COMETS' LIGHT.

Numerous observations have been made abroad upon comet *b*, 1881, to settle the question as to the origin of the light of these bodies. Messrs. Thury and Mayer at Geneva compared the brightness of the comet's head, as ascertained by photometric measurements, with the brightness it would have had if its light had been derived solely from the sun, by reflection. It was found that the intensity of the light of the nucleus, as it withdrew from the sun, diminished at first faster, and after a time slower than would have been the case, had it shone solely by reflected light. The decrease in intensity took place, in fact, as if the nucleus, during its approach to perihelion, had acquired through the force of the sun's rays an intrinsic light, which accompanied violent action of some character; this violent action ceasing after the comet had measured some distance on its return track, its light decreased speedily in conformity therewith, but the nucleus continued to glow as if in a state of incandescence, and remained visible, according to the above observers, longer than could have been expected.

This method seems to be well adapted to an independent determination of this interesting question. In the data it is a question, not of absolute, but of relative quantities. Ignorance of the physical condition and nature of a comet's reflecting surface renders it impossible to compute the intensity of its light under reflection alone, with any degree of certainty. As not the absolute light, however, but the increase or decrease under the circumstances, is required, the necessity for such knowledge is eliminated.

Another conclusion as to the origin of the comet's light has been reached by Respighi, from spectroscopic evidence. According to him there is no doubt that the light in part is reflected, as is proved by the appearance of the Fraunhofer lines in the photographs of the comet's spectrum. As to the bright lines or bands, they also may be caused by reflected light, as will be seen when it is taken into consideration what changes this light must have undergone after it has passed through the gases and vapors which form the whole mass of the comet. "It is certain," he continues, "that the largest part of the light emitted by the comet comes from its interior, and that it has passed through thick strata of gases and vapors. It is there subject to the selective absorption which is peculiar to these vapors and their combinations. It is accordingly natural that dark lines and bands should thence arise, which are different from the Fraunhofer lines; and with the weak, but complete, spectrum of the light that is reflected from the exterior substance of the comet, another spectrum must appear, which is considerably modified through powerful absorption."

"The limits of a simple notice do not permit me to enter in detail into my numerous spectroscopic observations of the Comet *b*, 1881. But I can affirm that it does not require the supposition of an intrinsic light to explain the phenomena which they exhibit. For the discontinuity of the spectrum might arise from the same cause as the broad, dark bands in the spectrum of the sun near the horizon, or in those of the planets. In the case of comets, however, the phenomenon is greatly exaggerated by the immense thickness of the absorbing strata, the rich character of their chemical constitution and the weakness of the light which they reflect to us. One must therefore proceed as in the case of the spectrum of our atmosphere, and not consider so much the bright bands as those dark through absorption."

A COMMITTEE has been formed at Reggio, (Emilia) to collect funds for establishing a fitting monument to the memory of the Padre Secchi, in the form of a fine refractor, of which the objective is to have 70 centimetres diameter. Reggio thus follows the example of Arcetri, where a fitting scientific monument has been erected to the memory of Galileo.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.]

LOUDNESS *vs.* INTENSITY OF SOUND.

To the Editor of "SCIENCE."

Will it seem like firing a blank cartridge at Copenhagen to urge that writers on acoustics ought more carefully to distinguish between the words loudness and intensity as applied to sound? We think not, so long as statements like the following are found in elementary manuals of physics; or so long as the language of even distinguished lecturers on Sound is not wholly free from similar indefinite expressions.

For instance, the law of variation in intensity of a sound free to move in a homogeneous medium is often stated in substance thus: the intensity *or loudness* of sound decreases as the square of the distance. As an illustration it is sometimes added, a sound at the distance two will be only one fourth as loud as at the distance one. While as a triumphant proof or verification of this law, it is often said: a single bell at the distance of ten yards will sound as loud as four similar bells at twenty yards.

It is well known that the word sound and several of the terms used in describing sound have two meanings. The word loudness primarily refers to the sensation of hearing. In order to avoid confusion of thought, I esteem it important that the use of this word be restricted to the sensation, and that the word intensity (or volume) shall refer solely to the external vibrations which are the cause of the sensation. In other words, loudness ought always to be used in a subjective, intensity in an objective, sense.

What is meant by such expressions as those above quoted? Perhaps they are simply examples of a loose use of language, but it will certainly be natural for the unwary reader to infer from them that loudness and intensity vary according to the same laws, and also that we can by the ear verify those laws. I have no hesitation in affirming that this use either purposely or otherwise, of the word loudness as synonymous with the word intensity, has been the cause of great confusion of thought, and has often loaded down the undulatory theory of sound with that which is really foreign to it. The time has come when we ought to regard that treatise on sound as a failure in one important respect which does not leave the reader thoroughly imbued with the idea that the law of variation in the intensity of a sound refers to sound vibrations and not to the intensity of the sensation of hearing.

But if those who use such expressions as have been quoted, really mean to claim that loudness, i. e., relative intensity of sensation, varies according to the same laws as the energy of the moving molecules of the sound wave, or if it is claimed that by the ear we can accurately and validly verify the law, then it will be in order to demand the proof.

In order that such physiological laws may be proved true it must be shown, either, 1, that we can accurately know when one of our sensations is a multiple of another (as when one sound is four times as loud to the ear as another), or, 2, that we can recognize sensations of equal intensity; and, 3, it must also be proved that the intensity of the sensation is proportional to the energy of the blow causing the sensation. These assumptions cannot be proved.

1. It goes without saying that any one having normal senses can tell a heavy blow from a light one, and can recognize degrees of intensity among sounds, lights, heats, tastes, and smells. But if it is claimed that there are quantitative relations between sensations of different intensity, and that we can by consciousness recognize these ratios, we at once become committed to a remarkable system of mathematics. Since experience shows that the senses are easily deceived and that different persons disagree as to their estimates, who shall decide what are the true ratios? But we can only compare the relative intensities of two sensations by memory. Here is a fruitful source of uncertainty, for before we can be sure that one sound is to our ears four times as loud as another, we must be certain that we can by memory reproduce the first sensation and place it beside the second in exactly its true intensity. No one can be sure of this. This reasoning applies to those who have perfect senses, if there are such. When we consider the myriad degrees of nerve sensitiveness, partly congenital, partly the result of habit, and partly the result of disease, the problem becomes still more difficult, ludicrously so.

2. Can we recognize sensations of equal intensity? No doubt we can do so much more exactly than we can estimate the relation between sensations varying greatly in intensity. Yet here we meet the same cause of doubt as before,—the uncertainty of memory. The less is the time intervening between two distinct and independent sensations, the more nearly we can estimate their true intensities. In comparing sounds, somewhat more than one sixteenth of a second must elapse between them. In the photometer the lights or shadows are shown in contrast and are thrown side by side upon the screen, where we can see them simultaneously or pass from one to the other very quickly. Probably there is no way whereby we can compare two sensations more accurately than by the photometer, yet no one will claim that he can move the lights so that their intensities shall be exactly equal on the screen. All he can say is: to the eye they are equal. If then under the most favorable conditions, there is a residuum of doubt, the sense of hearing will be still more untrustworthy; I regard it, therefore, as a fallacious method of research to bring physical laws to be tested by the uncertainties of sensation. Can feeling demonstrate the accuracy of a thermometer, or can the laws of energy be verified by striking ourselves blows with moving bodies? All that we can say is that within certain limits the testimony of our senses approximately conforms to the laws which have been deduced from more accurate observations and reasoning.

3. Are sensations proportional to the energy of the impacts producing them? They must be, if loudness and intensity vary according to the same laws, or if equal sensations are caused by equal blows. The hypothesis is manifestly absurd as a general law, for we are unconscious of very weak blows, and very violent ones either destroy the nerves or paralyze them by what is known as shock. Even within the most favorable limits the rule can only be approximately true, and if it were true, could not be proved, for the nerves retain their impressions for a variable length of time, and this marks a limit to the intervals at which we can repeat impressions of normal intensity free from the residual effect of previous impressions. Hence if impressions be repeated too soon they will generally cause a progressive deadening of the nerve sensitiveness, or sometimes an increased sensitiveness, as in the case of the punishment of the bastinado. Even if there were nervous conditions such that the sensation was proportional to the energy of the impact, it would be difficult if not impossible to prove that the nerves were in the proper condition at any given time. Into such a tangled maze of uncertainties are we led when we try to pervert our senses, admirable in their proper sphere, into mechanisms for the quantitative estimation of energy!

If it be said that a single bell at the distance one will sound as loud as four bells at the distance two, it must be assumed that the ear is equally well adapted for receiving and transmitting all sounds, irrespective of the shape of their wave front. I will omit from the following discussion all the complications which spring from differences in the pitch and timbre of sounds and will premise a perfect ear and nerves.

According to the undulatory theory of sound, the wave

XUM

front in a homogeneous medium is a spherical surface, and the rays of sound proceed outwards in all directions and in straight lines; hence the nearer is the source of sound, the more convex is the wave front and the more diverging are the rays. When the nearly parallel rays of sound proceeding from a distant point, strike the cup-shaped outer ear, a part is reflected toward the centre and thus reinforce the rays which directly enter the external opening of the ear. If a sound proceed from a point very near the ear the rays will be so diverging that all, except such as directly enter the opening, will be reflected outwards and will be lost. Hence it is evident that a far sound will seem louder than a near one, if their vibrations are of equal intensity as they come to the outer ear. This will at once upset the theory that loudness and intensity vary according to the same laws, unless in some way the far sound shall lose its advantage after entering the external meatus; but, as they enter the tube, the diverging rays of the near sound will strike obliquely outwards against the walls and will be reflected. Thus a part of their energy will be lost, a much larger proportionate loss than will come to the more parallel rays of the far sound. When at length after various reflections from the walls of the crooked meatus, the waves are wedged between one wall and the membrane of the tympanum which is placed obliquely across the inner end of the tube, the rays will fall upon the concave outer surface of the membrane, and a part will be converged. The more parallel rays of the distant sound will be more converged than those of the near sound, and hence will reinforce the impulse at the center of the membrane more than the other; but the center is the point of greatest leverage against the hammer bone which is fastened to the back of the membrane; hence nearly parallel rays of sound would more violently agitate the tympan of the inner ear than more diverging rays, even though both were of the same intensity before striking the concave membrane of the tympanum. The comparison by the ear of the intensities of two sounds would be still more untrustworthy if one of the sources of sound were within the outer tube of the ear.

Loudness, that is, the intensity of sound sensations, does not, then, depend upon the energy of the external sound vibrations, but upon the proportion of the energy which the mechanism of the ear is able to transmit to the auditory nerves, which amount is variable. The ear is so made as to relatively strengthen distant sounds and to weaken near ones, and it is so much the better an instrument because of this, for we are thereby saved from too violent shocks of the nerves, which are most likely to come from near sounds, while at the same time we retain a wide range of hearing. Such illustrations as that of the bells would not be chargeable with setting up a false test for the verification of physical laws, if it was not at the same time explained that the intensity of the sensation of hearing does not, and in consequence of the peculiar construction of the ear, cannot vary as the energy of the moving particles of the sound wave; also that at certain distances the testimony of the ear will approximately coincide, at other distances it will not coincide with the laws of intensity of sound which have been established by mathematical reasoning. The errors involved in the argument from the bells are very commonly held; it is not evident that all such arguments ought to be eliminated from treatises on sound, or at least that their true significance ought to be explained, and that the distinction should be more clearly defined between the subjective word loudness and objective word intensity.

GEORGE H. STONE.

COLORADO SPRINGS, *December 1st.*, 1881.

NEW YORK, *Dec. 19th.*

To the Editor of "SCIENCE."

In the official report of my paper read before the N. Y. Academy of Sciences, published in your last issue (Dec. 16th), I notice the cost of the balloon is given at about £12,000, whereas the amount should have been £4,000.

The report also states, "the great body of warm water that flows northward by the peninsula of Norway and Sweden strikes the lighter currents near the Pole and goes on as a submarine current, sweeping around the Pole till it goes out again through Smith's Sound." I desire to say that it is obvious that only a part of the current passes through Smith's Sound.

Respectfully,

JOHN P. CHEYNE, R.N., F.R.G.S.

To the Editor of "SCIENCE."

Sir,—In No. 12 of this year's *American Naturalist* I notice a short paragraph on 'fossil organisms in meteorites.' The subject certainly is interesting and it seems perfectly proper that the '*A. N.*' should at last take notice of it.

The only objection that I may be allowed to raise on behalf of "SCIENCE" and perhaps of myself is that the *American Naturalist* did not duly give credit for what had been reprinted from your columns.* I cannot conceive any plausible reason—unless it be an oversight—why this simple duty of editorial courtesy should be neglected by an American contemporary, while every English scientific journal takes pains to give due credit to "SCIENCE" for all the various data and notes which are gleaned from its columns (*e. g.* Jour. Microsc. Soc., *Lancet, Crookes' Journal, Journal of Science.*)

As to the sceptical remarks with which the *A. N.'s* paragraph concludes, to the effect that "a great deal more evidence will be required by biologists before crediting these alleged discoveries," I may refer all sceptics to Mr. Darwin's opinion, as reported in No. 61 of your valuable journal and to any (silicious) meteorite on which they can lay their hands and grind transparent sections from. This will go far to supply the wanted evidence.

Very respectfully,

GEO. W. RACHEL, M. D.

To the Editor of "SCIENCE."

NASHVILLE, TENN., *Nov.* 30, 1811,

Dear Sir,—I have to-day received from Mr. H. H. Warner, of Rochester, N. Y., $200 (two hundred dollars), the "Warner Comet Prize" for the discovery of Comet E, 1881, on Sept. 17.

Respectfully,

E. E. BARNARD.

MUSICAL FENCES.

In the abstract of an interesting paper by Prof. S. W. Robinson, in a recent number of "SCIENCE," the author begins with the statement that "this sketch is mainly of a simple fact of observation." He gives then a clear exposition of the acoustic phenomena observed by him in walking past picket fences, and the mathematical formula expressing the law of retrogression of pitch.

The observation is by no means new. I am unable to say at what time it was first published, if at all, but am sure that it was made nearly as far back as twenty years ago. On the crisp, cold morning of December 31st, 1861, while taking a walk with Prof. Joseph Le Conte, myself being innocent of mathematics on account of my youth, we noticed the whistling sound returned by a picket fence past which we were moving, our feet striking sharply against the frozen earth. My fondness for music made me particularly appreciative of a musical fence, and I have noticed the phenomenon hundreds of times since that date, knowing its explanation qualitatively, though I did not deduce the formula. If the fence be long, and the distance between the wickets considerable, the returning whistle may be much longer in duration than a quarter of a second. The stroke of a hammer on a board

*S. my paper on the subject in SCIENCE No. 50.

is a convenient substitute for that of the foot against the ground. I recently had a beautiful illustration while riding slowly on the horse-cars in New York. A vehicle passed rapidly between me and a picket fence, every stroke of its wheels against each stone of the pavement being returned as a whistle from the opposite fence. The acoustic effect was much like that of the trilling of a canary bird.

I cheerfully accord to Prof. Robinson the credit of giving mathematical expression to this truth. His observation is none the less original even if others have preceded him, and I am by no means sure that any one has preceded him in giving it publication.

W. LE CONTE STEVENS.
40 W. 40th St., NEW YORK.

Dec. 17th, 1881.

NOTES FROM OUR FOREIGN EXCHANGES.

Phosphorescent Fungi—At the present day, several inferior species of fungi are known, which have the power of throwing out a phosphorescent light. M. Crié, Professor of the Faculty of Sciences at Caen, has noticed new species which spring up on old stumps or between the bark and the wood of the elder-tree.

Rectification of Inferior Alcohol.—Electricity is now employed in the rectification of inferior alcohol. The electricity generated by a voltaic battery and a dynamo-electric machine is passed through the alcohol so as to disengage the superfluous hydrogen. By this means, beet-root alcohol, which is usually very poor, can be made to yield eighty per cent. of spirits, equal to that obtained from the best malt.

A Japanese Antelope.—Several interesting acquisitions have recently been made by the Zoological Garden of London. Among other rare animals, it has obtained a Japanese antelope which has never before been in any collection in Europe. The antelope of Japan (*Capricornus Crispus*) is found only in the highest mountains of the Niphon and Shikoku islands. Very little is known of its habits and it has been but incompletely described by Siebold in his Fauna of Japan.

Phosphorescent Ice—Mr. J. Allen has written to "Nature" an interesting letter, in which he describes a curious phenomenon of phosphorescence of floating ice, observed in the Polar regions. Every time that the bow of the ship, where the observer placed himself, shattered the ice during the night, the ice suddenly shone with a very perceptible light. It is a light similar to that which is produced on the breaking of sugar, the cleavage of sheets of mica, or the striking together of pieces of flint in the dark.

Electric Fusion of Metals—M. Siemens, in the presence of the members of the Congress of Electricians, performed the following curious experiment: in a crucible conveniently arranged, furnished with a perforated cover, fragments of steel were placed; the two currents of an electro-motor apparatus entered the lower and the upper part of the crucible. In 14 minutes the metallic mass became hot, reddened and melted. The mass showed no inflation. The expense of the combustile consumed by the electric apparatus is much less than that which fusion by direct application of heat would necessitate.

Electricity produced by Light.—While traveling in Mexico, M. Lœur, mining engineer, was struck by the fact that the *amalgamation* of silver ore, by what is called the *American* method, only operates well under the influence of light. According to him, the action does not take place in the darkness. He sought the cause of this unexpected effect and his experiments seemed to him, to show that light, by acting upon the mixture of sulphide of silver, sulphate of copper, salt and mercury, develops electricity without which the amalgamation cannot take place.

M. Boussingault, however, expressed an objection to this conclusion, which appears decisive; that in Mexico, the operation is not confined to small quantities, but whole mountains of ore are acted upon. Now light is only able to act upon the periphery of the latter, and the largest part of their mass remains in permanent darkness.

The Telephone in a Storm.—A very curious experiment was made and announced by M. René Thury, of Geneva. He stretched a metal wire from one roof to another. One extremity of the wire was in connection with a telephone, the opposite extremity with the earth. During a storm, every time there was a lightning stroke, even at a distance of 20, 30, and even 40 kilometres, the telephone gave a very characteristic sound. This noise, according to M. Fleury, was due to the peculiar electric currents, called currents of induction, produced under the influence of the atmospheric electric discharge. It was a sort of return impact.

The Sulphate of Alumina of Commerce.—For a long time there has been a tendency to substitute sulphate of alumina for potash or ammonia alum, since it is richer in alumina. But the manufacture of pure sulphate of alumina, that is to say, free from iron, is not easy, at least in an economical point of view.

During the last twenty years, pure hydrated alumina has been prepared at a low cost, and by saturating this alumina by sulphuric acid, a warm liquid is obtained which congeals into a dry and easily transportable mass of sulphate of alumina containing about 15 per cent. of alumina.

The products obtained in this manner are relatively expensive, and it would be a great advantage to purify the ferruginous sulphate of alumina furnished by the action of sulphuric acid upon common clay, if this purification could be accomplished by an easy and less costly method.

Extraction of Magnesia from Sea Water.—The Moniteur des produits chimiques contains the following method of abstracting magnesia from sea water: "magnesia can be precipitated from sea water by means of calcium, just as from other more concentrated solutions. After precipitation and rest for a day, a cubic metre of sea water gives a precipitate of gelatinous magnesia, about 80 litres in volume. The treatment on a large scale of water whose magnesia is to be deposited in large basins, can easily be accomplished, speaking in an industrial point of view; the calcium will be the greatest expense.

If the magnesian sediment thus obtained is treated with phosphoric acid, a precipitate of tribassic phosphate is obtained, which, filtered, becomes an excellent chemical agent for the precipitation of ammonia from excrements in the form of ammoniac-magnesian sulphate, which is a powerful manure.

Spontaneous Combustion of Carbon.—Spontaneous combustion in colliers is a very important question, for, in 1874, 70 cases of this kind occurred. The recent investigations of M. Haedicke have thrown light upon this subject. These experiments were conclusive in proving that this combustion is due to the influence of iron pyrites. This substance becomes oxidized when submitted to moisture and is changed into ferrous sulphate. During this decomposition, the carbon bursts and offers a larger surface to the action of the air. The ferrous salt is then transformed into a ferric salt which yields up its oxygen to the carbon. In order to prevent spontaneous ignition, all currents of air should be excluded, unless they should be allowed to enter from the beginning in great quantities, so that the air acts as a cooling agent. As moisture prevents ignition and the accumulation of oxygen, the introduction of a jet of steam, where the temperature of the carbon has been raised to a high degree, will also act as a preventive.

Sea-sickness.—A correspondent of the "Paris Medical" has sent a communication to the editor, which will prove interesting to many persons who suffer sea-sickness in their travels.

"In a recent voyage from Algeria to France," he writes, "the sea being very rough, and almost all the passengers being sick, the officers of the ship could offer but insufficient means of relief. Among the passengers there was one, about thirty years old, who suffered cruelly. He vomited continually for thirty hours, and his sufferings became so severe that the surgeon had to be called. After hearing him prescribe lemon juice, I asked him if he had not morphine or chloral. To my astonishment he replied that he had none. I then offered him one centigram of morphine and my syringe. This was accepted. A solution was made in 20 drops of water, was injected into the epigastrium, and, a half hour afterwards the sickness was allayed. He ceased

vomiting and remained unmolested during the rest of the journey. This fact appeared remarkable to me. The benefit had been immediate." If this observation can be confirmed by other similar cases, it would be very fortunate, for then the surgeons of the maritime and transatlantic companies would be able to relieve passengers who suffer seasickness.

THE SEPARATION OF WOOL AND SILK IN WOVEN GOODS.—A. Rémont.—The following method is sufficiently exact for commercial purposes: the sample is kept for a quarter of an hour in boiling water containing 5 per cent. of hydrochloric acid, and is then washed and dried. The threads of the warp are then separated, if possible, from those of the weft, and examined separately as follows: a thread is burnt. There is given off a smell like burning horn, and a thread heated with a fragment of caustic soda evolves ammonia. In this case some threads are plunged in basic zinc chloride at a boil. If they dissolve completely the threads are *silk*. If on adding hydrochloric acid there is a plentiful flocculent precipitation, the threads are silk mixed with wool or with vegetal fibres. If nothing dissolves in zinc chloride, the threads are plunged in a boiling solution of soda, not too concentrated. If they dissolve completely, *wool*. If partially, *wool* and *cotton*. If no odor of burnt horn is given off, the threads consist entirely of vegetal fibres. These results may be confirmed by means of the microscope. For the quantative examination, if the preliminary tests show silk, wool, and cotton, four swatches weighing each 4 grms. are cut; one is laid aside and the three others are boiled.—*Journal de Pharmacie et de Chimie.*

THE REDUCTION OF COPPER SOLUTION BY GLUCOSE* appears first to have been utilized by Trömmer. Frommherz suggested the employment of a citrate to keep the cupric oxide in solution. Modifications of the ordinary alkaline tartrate solution have been devised by Barreswil, Poggiale, Rosenthal, Chevalier, Boussingault, Reveil, Fehling Strohl, Viollette, Magneshahens, Lowenthal, Joulie, Pos soz, etc. Loewe employed glycerin instead of a tartrate. Various treatments of the precipitated cuprous oxide have been proposed by the following chemists: Mohr dissolves the oxide in hydrochloric acid, and titrates with permanganate. Brunner dissolves in an acid solution of ferric chloride, and estimates the reduced iron by bichromate or permanganate. Champion and Pellet dissolve the precipitate in hydrochloric acid and chlorate of potassium, boil off free chlorine, and titrate the liquid with stannous chloride. Girard and Soxhlet reduce the cuprous oxide in hydrogen, and weigh the metallic copper. Muter dries the cuprous oxide at 100° C., and weighs it as Cu_2O. O'Sullivan and other operators ignite the precipitate strongly, and weigh as CuO. Ferdinand-Jean dissolves the cuprous oxide in hydrochloric acid, and weighs the metallic silver precipitated on adding ammoniacal silver nitrate. Maumené uses an excess of copper solution, filters, adds ammonia to the filtrate, and estimates the residual copper by titration with sodium sulphide, for which Perrot substitutes potassium cyanide. Lastly, Pavy adds ammonia to the alkaline cupric solution, and runs in the sugar solution till the hot liquid is decolorized.

* From an Advance-Shee of Allen's "Commercial Organic Analysis," vol. ii.

MET OROLOGICAL REPORT FOR NEW YORK CITY FOR THE WEEK ENDING DEC. 17, 1881.

Latitude 0° 45′ 58″ N.; Longitude 73° 57′ 58″ W.; height of instruments above the ground, 53 feet; above the sea, 97 feet; by self-recording instruments.

DECEMBER.	BAROMETER. MEAN FOR THE DAY. Reduced to Freezing.	MAXIMUM. Reduced to Freezing.	MAXIMUM. Time.	MINIMUM. Reduced to Freezing.	MINIMUM. Time.	THERMOMETERS. MEAN. Dry Bulb.	MEAN. Wet Bulb.	MAXIMUM. Dry Bulb.	MAXIMUM. Time.	MAXIMUM. Wet Bulb.	MAXIMUM. Time.	MINIMUM. Dry Bulb.	MINIMUM. Time.	MINIMUM. Wet Bulb.	MINIMUM. Time.	MAXI'M In Sun
Sunday, 11..	30.432	30.476	12 p. m.	30.362	0 a. m.	27.0	25.7	31	4 p. m.	29	4 p. m.	20	7 a. m.	20	7 a. m.	93.
Monday, 12..	30.292	30.476	0 a. m.	30.110	12 p. m.	38.0	36.0	45	6 p. m.	43	6 p. m.	29	6 a. m.	29	6 a. m.	74.
Tuesday, 13..	30.021	30.110	0 a. m.	29.938	12 p. m.	51.3	47.6	59	12 p. m.	54	12 p. m.	41	5 a. m.	40	5 a. m.	95.
Wednesday, 14 ..	29.806	29.938	0 a. m.	29.688	4 p. m.	56.3	52.7	67	4 a. m.	60	4 p. m.	40	12 p. m.	40	12 p. m.	69.
Thursday, 15..	30.177	30.322	12 p. m.	29.900	0 a. m.	30.3	29.6	40	0 p. m.	40	0 a. m.	26	12 p. m.	26	12 p. m.	60.
Friday, 16..	30.427	30.492	11 a. m.	30.322	0 a. m.	24.0	23.0	29	11 p. m.	28	11 p. m.	18	7 a. m.	18	7 a. m.	92.
Saturday, 17..	30.232	30.396	0 a. m.	30.176	12 p. m.	33.7	31.3	40	0 a. m.	36	4 p. m.	25	4 a. m.	25	4 a. m.	88.

		Dry.	Wet.
Mean for the week	30.198 inches.	37.2 degrees	35.1 degrees.
Maximum for the week	30.492 "	67. " at 4 pm 14th,	60. "
Minimum " at	29.688 "	18. " at 7 am 16th,	18. "
Range	.804 "	49. "	42.

DECEMBER.	WIND. DIRECTION. 7 a. m.	2 p. m.	9 p. m.	VELOCITY IN MILES. Distance for the Day.	FORCE IN LBS. PER SQR. FEET. Max.	Time.	HYGROMETER. FORCE OF VAPOR. 7 a. m.	2 p. m.	9 p. m.	RELATIVE HUMIDITY. 7 a. m.	2 p. m.	9 p. m.	CLOUDS. CLEAR, 0 OVERCAST, 10. 7 a. m	2 p. m.	9 p. m.	RAIN AND *SNOW. DEPTH OF RAIN AND SNOW IN INCHES. Time of Beginning.	Time of Ending.	Duration h. m	Amount of water	OZONE.
Sunday, 11.	n. w.	w.	s. w.	125	1½	4.30 pm	.108	.130	.137	100	78	79	0	4 cir. cu.	2 cir. cu.	-----	-----	----	--	0
Monday, 12.	e.	s.	s. w.	187	7	7.20 pm	.149	.177	.244	89	66	91	9 cu.	10	10	7 pm	10 pm	3.00	.03	0
Tuesday, 13.	s. w.	w. s. w.	w. s. w.	274	6½	3 50 pm	.244	.282	.336	91	67	70	10	4 cir. cu.	5 cu.	-----	-----	-----	--	0
Wednesday, 14.	s. w.	s. w.	n. n. e.	303	6	10.50 am	.367	.420	.288	71	68	100	8 cu.	9 cu.	10	9 am	12 pm	15.00	.40	10
Thursday, 15.	n. w.	n.	n. n. w.	238	4½	3.15 am	.181	.137	.153	100	79	100	10	8 cir. cu.	0	0 am	8.30 am	8.30	.40	9
Friday, 16.	n. n. e.	n. n. e.	n. w.	128	2	2.20 am	.098	.106	.136	100	75	88	0	0	0	-----	-----	-----	--	0
Saturday, 17.	w. s. w.	w. s. w.	w.	263	3½	3.00 pm	.141	.144	.157	100	63	71	1 cir.	2 cir.	0	-----	-----	-----	--	0

Distance traveled during the week	1,518	miles.	Total amount of water for the week	.83 inch.
Maximum force	7	lbs.	Duration of rain	1 day, 2 hours, 30 minutes.

* Thursday, 15th, 1¼.

DANIEL DRAPER, Ph. D.

Director Meteorological Observatory of the Department of Public Parks, New York.